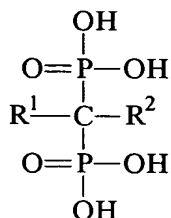


WHAT IS CLAIMED IS:

1. An etching composition comprising:  
a polymerizable component; and  
a compound of Formula I, which is different from the polymerizable  
5 component, wherein Formula I is:

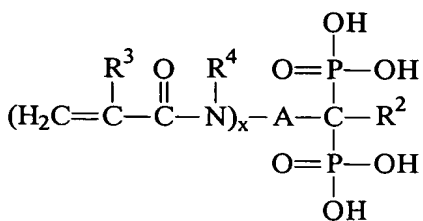


(I)

or a salt thereof, wherein:

- 10  $\text{R}^1$  is an organic group that includes a polymerizable group; and  
 $\text{R}^2$  is H, OR, SR, N(R)<sub>2</sub>, or an organic group that can optionally  
join with  $\text{R}^1$  to form a carbon-carbon double bond with the carbon  
between the two phosphorus atoms, wherein the organic group optionally  
includes a polymerizable group, and further wherein each R is  
15 independently hydrogen or an organic group optionally including a  
polymerizable group;  
wherein the compound of Formula I is present in an amount sufficient to  
etch a hard surface, thereby forming an etchant.

- 20 2. An etching composition comprising:  
a polymerizable component; and  
a compound of Formula II, which is different from the polymerizable  
component, wherein Formula II is:



(II)

or a salt thereof, wherein:

$x = 1-3$ ;

$\text{R}^2$  is H, OH, an alkyl group, an aryl group, an alkoxy group, an  
 5 aryloxy group, or  $-\text{A}-(\text{N}(\text{R}^4)-\text{C}(\text{O})-\text{C}(\text{R}^3)=\text{CH}_2)_x$ ;

each  $\text{R}^3$  is independently H or  $\text{CH}_3$ ;

each  $\text{R}^4$  is independently H, an alkyl group, or can be joined to A  
 forming a cyclic organic group; and

A is a straight chain or branched organic group;

10 wherein the compound of Formula II is present in an amount sufficient to  
 etch a hard surface, thereby forming an etchant.

3. The composition of claim 2 wherein the composition is a self-etching  
 primer.

15

4. The composition of claim 2 wherein the composition is a self-etching  
 adhesive.

5. The composition of claim 2 wherein each  $\text{R}^4$  is independently a (C1-  
 20 C4)alkyl group.

6. The composition of claim 2 wherein each  $\text{R}^4$  is independently H.

7. The composition of claim 2 wherein  $\text{R}^2$  is a (C1-C4)alkoxy group.

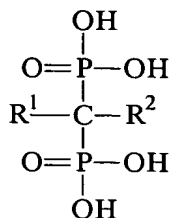
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8. The composition of claim 2 wherein  $\text{R}^2$  is OH.

9. The composition of claim 2 wherein A is  $(\text{CH}_2)_n$  wherein  $n = 1-20$ .

10. The composition of claim 9 wherein  $n = 3-11$ .
11. The composition of claim 10 wherein  $n = 5$ .
- 5 12. The composition of claim 2 wherein the compound of Formula II is present in an amount of at least about 1 wt-%, based on the total weight of the composition.
- 10 13. The composition of claim 2 wherein the polymerizable component is selected from the group consisting of ethylenically unsaturated compounds.
14. The composition of claim 2 wherein the polymerizable component is selected from the group consisting of 2-hydroxyethyl methacrylate (HEMA), polyethyleneglycol dimethacrylate (PEGDMA), copolymer of acrylic acid:itaconic acid with pendent methacrylate (AA:ITA:IEM), 2,2-bis[4-(2-hydroxy-3-methacryloxypropoxy)phenyl]propane (bisGMA), urethane dimethacrylate (UDMA), and glycerol dimethacrylate (GDMA), and combinations thereof.
- 15 20 15. The composition of claim 2 further comprising an adhesive component.
16. The composition of claim 2 further comprising a primer component.
17. The composition of claim 2 further comprising a filler.
- 25 18. The composition of claim 2 further comprising water or a nonaqueous solvent.
19. The composition of claim 2 further comprising a photoinitiator.
- 30 20. The composition of claim 2 further comprising an oxidizing agent and a reducing agent.
21. The composition of claim 2 wherein the hard surface is dentin or enamel.

22. A composition comprising:  
 a polymerizable component; and  
 a compound of Formula I, which is different from the polymerizable  
 5 component, wherein Formula I is:

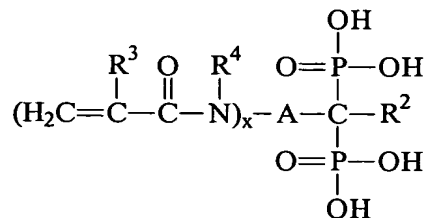


(I)

or a salt thereof, wherein:

- 10  $\text{R}^1$  is an organic group that includes a polymerizable group; and  
 $\text{R}^2$  is H, OR, SR, N(R)<sub>2</sub>, or an organic group that can optionally  
 join with  $\text{R}^1$  to form a carbon-carbon double bond with the carbon  
 between the two phosphorus atoms, wherein the organic group optionally  
 includes a polymerizable group, and further wherein each R is  
 15 independently hydrogen or an organic group optionally including a  
 polymerizable group;  
 wherein the compound of Formula I is present in an amount of at least  
 about 1 wt-%, based on the total weight of the composition.

23. A composition comprising:  
 20 a polymerizable component; and  
 a compound of Formula II, which is different from the polymerizable  
 component, wherein Formula II is:



(II)

or a salt thereof, wherein:

$x = 1-3$ ;

5  $R^2$  is H, OH, an alkyl group, an aryl group, an alkoxy group, an aryloxy group, or  $-A-(N(R^4)-C(O)-C(R^3)=CH_2)_x$ ;

each  $R^3$  is independently H or  $CH_3$ ;

each  $R^4$  is independently H, an alkyl group, or can be joined to A forming a cyclic organic group; and

A is a bond or a straight chain or branched organic group;

10 wherein the compound of Formula II is present in an amount of at least about 1 wt-%, based on the total weight of the composition.

24. The composition of claim 23 wherein the composition is an etchant for a hard surface.

15 25. The composition of claim 23 wherein the composition is a self-etching primer.

26. The composition of claim 23 wherein the composition is a self-etching adhesive.

27. The composition of claim 23 wherein each  $R^4$  is independently a (C1-C4)alkyl group.

25 28. The composition of claim 23 wherein each  $R^4$  is H.

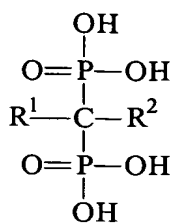
29. The composition of claim 23 wherein  $R^2$  is a (C1-C4)alkoxy group.

30. The composition of claim 23 wherein  $R^2$  is OH.

30 31. The composition of claim 23 wherein A is  $(CH_2)_n$  wherein  $n = 1-20$ .

32. The composition of claim 31 wherein  $n = 3-11$ .

33. The composition of claim 32 wherein  $n = 5$ .
38. The composition of claim 23 wherein the compound of Formula II is present in an amount of at least about 5 wt-%, based on the total weight of the composition.
39. The composition of claim 23 wherein the polymerizable component is selected from the group consisting of ethylenically unsaturated compounds.
40. The composition of claim 39 wherein the polymerizable component is selected from the group consisting of HEMA, PEGDMA, AA:ITA:IEM, bisGMA, UDMA, GDMA, and combinations thereof.
41. The composition of claim 23 for bonding a dental restorative to a hard surface.
42. The composition of claim 41 wherein the hard surface is dentin or enamel.
43. The composition of claim 23 further comprising an adhesive component.
44. The composition of claim 23 further comprising a filler.
45. The composition of claim 23 further comprising water or a nonaqueous solvent.
46. A method of treating a hard surface, the method comprising:  
etching the hard surface with a composition comprising a compound of the following Formula I:



(I)

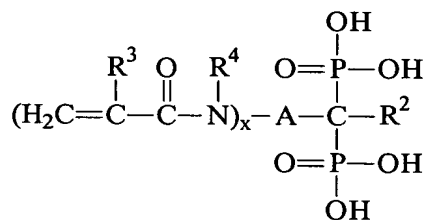
or a salt thereof, wherein:

$\text{R}^1$  is an organic group that includes a polymerizable group; and

$\text{R}^2$  is H, OR, SR,  $\text{N}(\text{R})_2$ , or an organic group that can optionally  
 5 join with  $\text{R}^1$  to form a carbon-carbon double bond with the carbon  
 between the two phosphorus atoms, wherein the organic group optionally  
 includes a polymerizable group, and further wherein each R is  
 independently hydrogen or an organic group optionally including a  
 polymerizable group;  
 10 with the proviso that the hard surface is not pretreated.

47. A method of treating a hard surface, the method comprising:  
 etching the hard surface with a composition comprising a compound of  
 the following Formula II:

15



(II)

or a salt thereof, wherein:

$x = 1-3$ ;

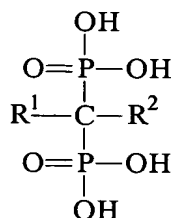
20  $\text{R}^2$  is H, OH, an alkyl group, an aryl group, an alkoxy group, an  
 aryloxy group, or  $-\text{A}-(\text{N}(\text{R}^4)-\text{C}(\text{O})-\text{C}(\text{R}^3)=\text{CH}_2)_x$ ;  
 each  $\text{R}^3$  is independently H or  $\text{CH}_3$ ;  
 each  $\text{R}^4$  is independently H, an alkyl group, or can be joined to A  
 forming a cyclic group; and

A is a bond or a straight chain or branched organic group;  
with the proviso that the hard surface is not pretreated.

48. The method of claim 47 wherein the composition etches and primes the  
5 hard surface.

49. The method of claim 48 wherein the hard surface is a hard tissue.

50. A method of treating a tooth surface, the method comprising:  
10 etching the tooth surface with a composition comprising a compound of  
the following Formula I:



(I)

15 or a salt thereof, wherein:

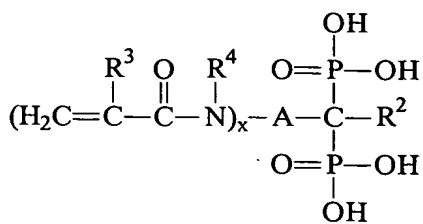
$\text{R}^1$  is an organic group that includes a polymerizable group; and

$\text{R}^2$  is H, OR, SR,  $\text{N}(\text{R})_2$ , or an organic group that can optionally  
join with  $\text{R}^1$  to form a carbon-carbon double bond with the carbon  
between the two phosphorus atoms, wherein the organic group optionally  
20 includes a polymerizable group, and further wherein each R is  
independently hydrogen or an organic group optionally including a  
polymerizable group;  
with the proviso that the tooth surface is not pretreated with phosphoric  
acid.

25

51. A method of treating a tooth surface, the method comprising:  
etching the tooth surface with a composition comprising a compound of  
the following Formula II:





(II)

or a salt thereof, wherein:

$x = 1-3$ ;

5  $\text{R}^2$  is H, OH, an alkyl group, an aryl group, an alkoxy group, an aryloxy group, or  $-\text{A}-(\text{N}(\text{R}^4)-\text{C}(\text{O})-\text{C}(\text{R}^3)=\text{CH}_2)_x$ ;

each  $\text{R}^3$  is independently H or  $\text{CH}_3$ ;

each  $\text{R}^4$  is independently H, an alkyl group, or can be joined to A forming a cyclic organic group; and

10 A is a bond or a straight chain or branched organic group; with the proviso that the tooth surface is not pretreated with phosphoric acid.

52. The method of claim 51 wherein the composition further comprises at  
15 least one polymerizable component different from the compound of Formula II.

53. The method of claim 52 wherein the composition functions as a self-etching primer thereby etching and priming the tooth surface simultaneously.

20 54. The method of claim 52 wherein the composition functions as a self-etching adhesive to promote adherence of a dental material to the tooth surface.

55. The method of claim 54 wherein the dental material is selected from the group consisting of a composite, a filling, a sealant, an inlay, an onlay, a crown,  
25 and a bridge.

56. The method of claim 52 wherein the composition functions to promote the adherence of an orthodontic adhesive to the tooth surface, wherein the

orthodontic adhesive functions to adhere an orthodontic appliance to the tooth surface.

57. The method of claim 56 wherein the orthodontic appliance is selected  
5 from the group consisting of a bracket, a buccal tube, a band, a cleat, a button, a lingual retainer, and a bite blocker.

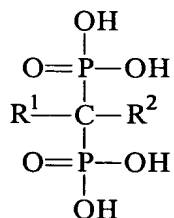
58. The method of claim 51 further comprising a step of priming the tooth  
10 surface.

59. The method of claim 51 further comprising a step of applying a dental  
adhesive to the tooth surface.

60. The method of claim 51 wherein the tooth surface comprises enamel.  
15

61. The method of claim 51 wherein the tooth surface comprises dentin.

62. A method of adhering an orthodontic appliance to a tooth surface, the  
method comprising:  
20 etching the tooth surface with a composition comprising a compound of  
the following Formula I:



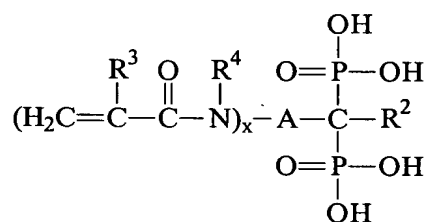
(I)

or a salt thereof, wherein:

25  $\text{R}^1$  is an organic group that includes a polymerizable group; and  
 $\text{R}^2$  is H, OR, SR, N(R)<sub>2</sub>, or an organic group that can optionally  
join with  $\text{R}^1$  to form a carbon-carbon double bond with the carbon  
between the two phosphorus atoms, wherein the organic group optionally  
includes a polymerizable group, and further wherein each R is

independently hydrogen or an organic group optionally including a polymerizable group; and  
adhering an orthodontic appliance to the tooth surface.

- 5 63. A method of adhering an orthodontic appliance to a tooth surface, the method comprising:  
etching the tooth surface with a composition comprising a compound of the following Formula II:



(II)

or a salt thereof, wherein:

$x = 1-3$ ;

$\text{R}^2$  is H, OH, an alkyl group, an aryl group, an alkoxy group, an aryloxy group, or  $-\text{A}-(\text{N}(\text{R}^4)-\text{C}(\text{O})-\text{C}(\text{R}^3)=\text{CH}_2)_x$ ;

each  $\text{R}^3$  is independently H or  $\text{CH}_3$ ;

each  $\text{R}^4$  is independently H, an alkyl group, or can be joined to A forming a cyclic organic group; and

A is a bond or a straight chain or branched organic group; and  
adhering an orthodontic appliance to the tooth surface.

20

64. The method of claim 63 further comprising adhering an orthodontic adhesive to the tooth surface.

65. The method of claim 64 wherein the orthodontic adhesive has been pre-  
25 applied to the orthodontic appliance before adhering to the tooth surface.

66. The method of claim 63 wherein the orthodontic appliance is selected from the group consisting of a bracket, a buccal tube, a band, a cleat, a button, a lingual retainer, and a bite blocker.

67. The method of claim 63 further comprising a step of priming the tooth surface prior to adhering an orthodontic appliance to the tooth surface.
- 5 68. The method of claim 67 wherein the composition further comprises at least one polymerizable component different from the compound of Formula II and wherein the steps of etching and priming are done simultaneously with the composition functioning as a self-etching primer composition.
- 10 69. The method of claim 68 further comprising adhering an orthodontic adhesive to the tooth surface.
70. The method of claim 69 wherein the orthodontic adhesive has been pre-applied to the orthodontic appliance before adhering to the tooth surface.
- 15 71. The method of claim 63 further comprising a step of applying a dental adhesive to the tooth surface prior to adhering an orthodontic appliance to the tooth surface.
- 20 72. The method of claim 71 wherein the composition further comprises at least one polymerizable component different from the compound of Formula II and wherein the steps of etching and applying a dental adhesive are done simultaneously with the composition acting as a self-etching adhesive composition.
- 25 73. The method of claim 72 further comprising adhering an orthodontic adhesive to the tooth surface.
74. The method of claim 73 wherein the orthodontic adhesive has been pre-
- 30 applied to the orthodontic appliance before adhering to the tooth surface.